

Nervous System consists of brain, spinal cord, sense receptors and a whole lot of nerves.

Average number of neurons in the human brain = 100 billion.

Neuron: The Unit of nervous System

Our nervous system consists of brain, spinal cord, sense receptors and a whole lot of nerves. The brain and spinal cord are made up of neurons or nerve cells.

Structure of the neuron: The three main parts of a neuron are the cell body, dendrites and axon.

(i) The cell body (Perikaryon or Cyton)
(peri : surrounding, karyon : nucleus)

- It contains a well-defined nucleus, surrounded by granular cytoplasm.
- It has all the cell organelles like other cells, only centrosome is absent because nerve cells have lost the ability to divide.

(ii) Dendrites (dendron tree/branch):

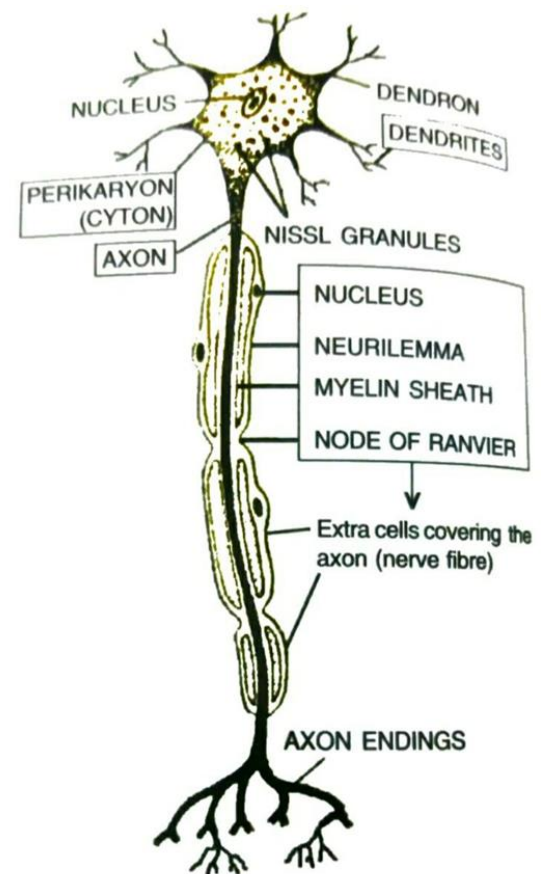
These are branched cytoplasmic projections of the cell body. They conduct nerve impulses to the cyton.

(iii) Axon:

- It is a long process from the cell body.
- It is surrounded by white insulating sheath called **myelin sheath** which is covered by outermost thin sheath called **neurolemma**.

The gap in myelin sheath is called **node of ranvier**. Axon terminals are closely placed near dendrites of another neuron through a gap called **synaptic cleft**

Synapse- is the point of contact between terminal branches of the axon of a neuron with dendrites of another neuron separated by a fine gap. A chemical Acetylcholine is released.



The nervous system can transmit signals at speeds of 100 meters per second. The field of science that focuses on the study of the nervous system is called **neuroscience**.

Types of Neurons :

Sensory Neuron – brings impulse from receptor to brain.

Motor Neuron- carry impulse from brain to effector.

Association Neuron- interconnects the sensory and motor neuron

Nerve is bundle of nerve fibres (axons) of separate neurons. They emerge from brain and spinal cord and branch out to all parts of the body. They are of 3 types: sensory, motor and mixed nerve.

Ganglia is collection of Cytons/ Cell bodies.

Two major divisions of the Nervous System:

1. Central Nervous System (CNS) includes the brain and the spinal cord contained within the vertebral column.

2. Peripheral nervous system (PNS) includes the nerves that emerge from and enter into the brain and spinal cord.

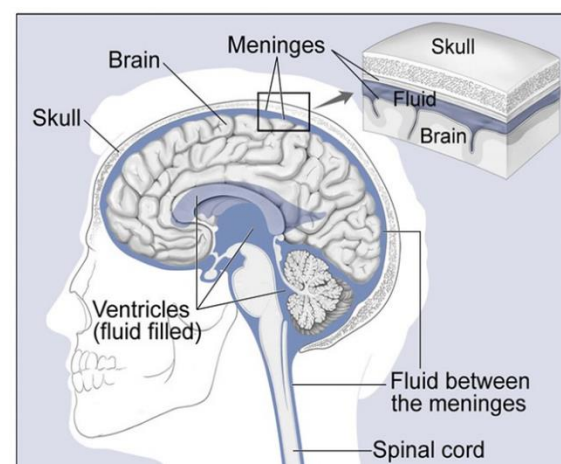
The **PNS** consists of two subdivisions:

A. **Somatic nervous system (SNS)** conveys information to skeletal (voluntary) muscles.

B. **Autonomic nervous system (ANS)** includes a pair of chains of ganglia and nerves which control the involuntary actions of many internal organs (smooth muscles, heart muscles and glands).

The Brain: The brain is a very delicate organ well protected inside the **brain box or cranium** of the skull.

Coverings: The brain is protected by 3



membranous coverings **called meninges** (meninx: membrane) which continue backwards on the spinal cord.

- (i) **Dura mater** - the outermost tough fibrous membrane .
- (ii) **Arachnoid**- the thin delicate middle layer giving a web-like cushion.
- (iii) **Pia mater**- the innermost highly vascular membrane, richly supplied with blood.

Inflammation of meninges is **Meningitis**.

Parts of the Brain:

The brain has three main parts visible externally,

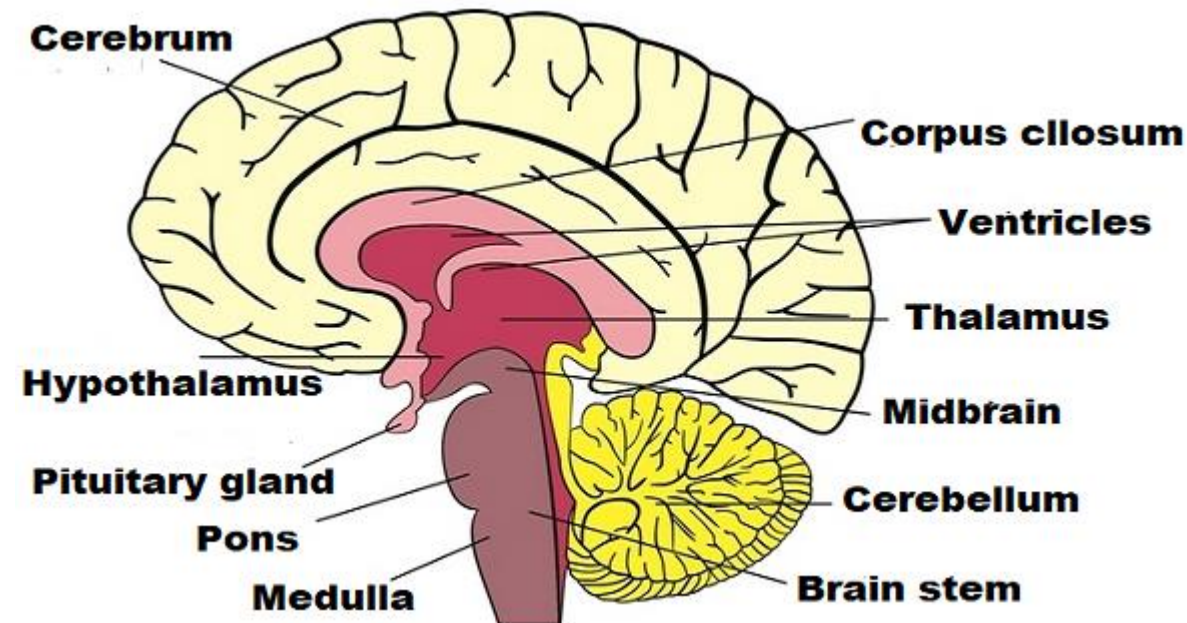
- (1) cerebrum
- (2) cerebellum
- (3) medulla oblongata

1) Cerebrum (cerebrum: brain)

The cerebrum is the *largest portion of the brain*. It is divided into two (right and left) halves **called cerebral hemispheres**. Their outer surface is highly convoluted with *ridges and grooves*. Each cerebral hemisphere is hollow internally and the walls have two regions - an outer(cortex) and an inner portion (medulla).

The outer portion (cortex) of the cerebrum contains cell bodies of the neurons and, being grayish in colour, is called the **gray matter**.

The Inner part is white due to Axons so called **white matter**.



Functions - It is seat of intelligence, consciousness, and will power And Subconscious mind and all voluntary actions.

2. CEREBELLUM ("little brain")

The cerebellum is a much smaller area of the brain located just at the base and under the large cerebrum. It has, but has numerous furrows no convolutions. This also has an outer cortex made of gray matter. Centrally, it has white matter which, in a median section, appears like a branching tree.

The main function of the cerebellum is to maintain 'balance' of the body and coordinate muscular activity.

3) MEDULLA OBLONGATA

The medulla oblongata is the lowest portion of the brain located at the base of the skull. It is roughly triangular and is continued behind as the spinal cord.

Its function is **to control the activities of the internal organs**, for example, peristaltic movement of the alimentary canal, movement of breathing, beating of the heart and many other involuntary actions.

Three Primary Regions of the Brain:

All parts taken together, the brain may be said to consist of three primary regions forebrain, midbrain and hindbrain. The various parts under each region and their principal functions are as follows:

1. Forebrain:

a) **Cerebrum** (cerebral hemispheres) (seat of intelligence, memory, consciousness, will power, voluntary actions).

b) Diencephalon

(i) **Thalamus** (relays pain and pressure impulses to cerebrum).

(ii) **Hypothalamus** (controls the body temperature and pituitary).

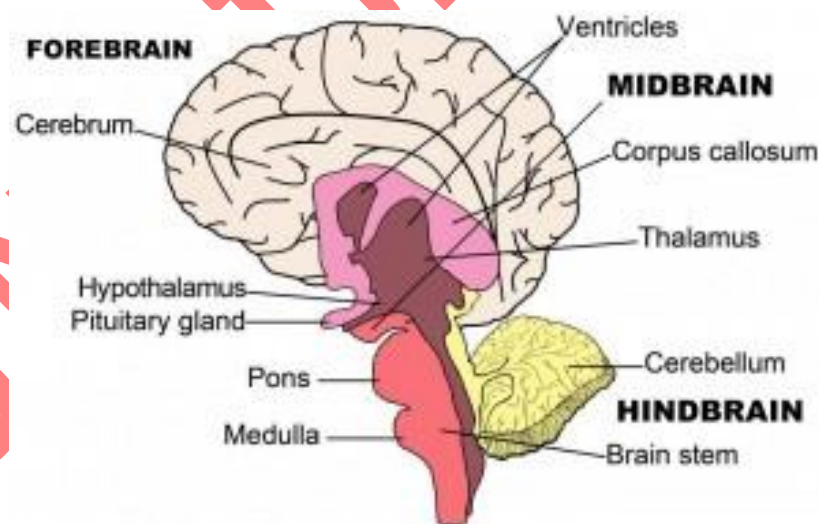
2. Midbrain: A small tubular part (reflexes involving eyes and ears).

3. Hindbrain:

a) **Cerebellum** (coordinates muscular act balance of the body).

b) **Pons** located in the centre of the brain - below the cerebellum (carries impulses one hemisphere of the cerebellum to the other hemisphere and coordinates muscular movements on both the sides of the body).

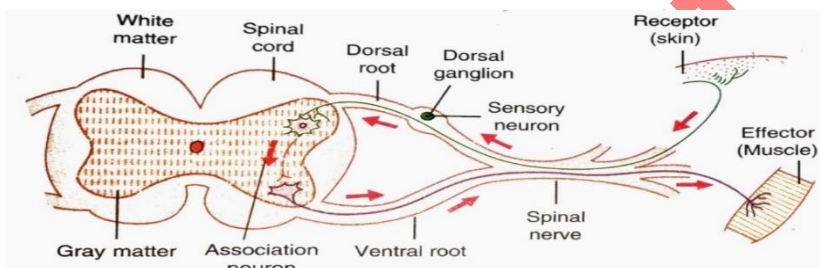
c) **Medulla oblongata** (controls activities of internal organs, heart beat, breathing, etc.)



The spinal cord

The spinal cord extends from the medulla of the brain down almost the whole length of the backbone to end at the second lumbar vertebra and lies within the neural canal of the vertebrae.

Spinal Cord has the



arrangement of white and the gray matter is reversed from that in the brain. The matter containing the cell bodies of motor (efferent) and association neurons lies on the inner side and the white matter on the outer side. There is a small **central canal** in the center which runs the entire length and is continuous with the cavities of the brain. It is also filled with **cerebrospinal fluid** which acts as a shock proof cushion and forms a medium for the exchange of food materials, waste products, and respiratory gases with neurons.

Functions of the Spinal Cord

The spinal cord is concerned with the following three functions:

- (i) Reflexes below the neck.
- (ii) Conducts sensory impulses from the skin and muscles to the brain.
- (iii) Conducts motor responses from the brain to muscles of the trunk and limbs.

Peripheral Nervous system (PNS)

It includes nerves which carry impulses to and from CNS.

- (1) Cranial Nerves – They emerge from brain and are 12 pairs.
- (2) Spinal nerves – They emerge from the spinal cord and are 31 pairs.

Autonomic Nervous System (ANS)

Consist of nerves and ganglia which controls involuntary actions . Like

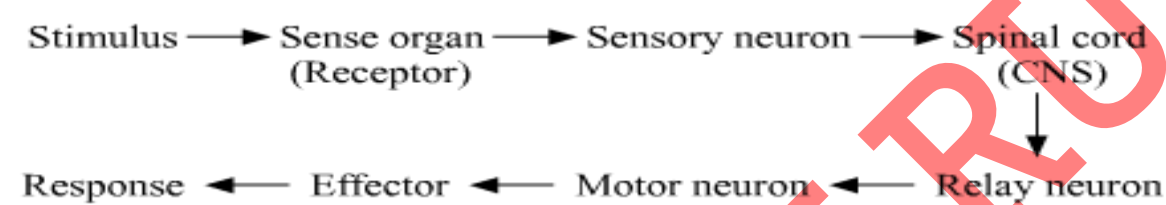
Heart rate, Salivation, pupil control etc (a) Sympathetic and (b) Parasympathetic

Sympathetic prepares body for violent actions where as parasympathetic reestablishes normal conditions.

Reflexes (Involuntary Actions)

The term “reflex” comes from the Latin word “reflexus” meaning reflected or directed back. It is automatic involuntary action in the body brought about by a stimulus.

Reflex arc is the shortest route that can be taken by an impulse from receptor to an effector.



Two types of actions which occur in our body are:

1. Voluntary Actions
2. Involuntary Actions

Natural reflex: No previous learning is needed. These are inborn ex: blinking, coughing, knee jerk, closing of eyelids, sneezing etc

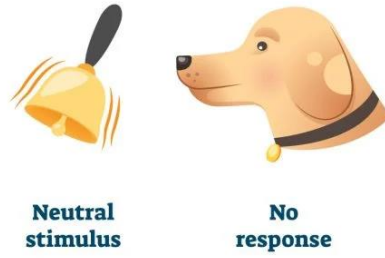
Conditioned reflex: Acquired during lifetime or experience . Ex- Salivation on seeing favourite food, standing up on teacher's entry, giving signal of hand on turning

Pavlov's Experiment on Dog

CONDITIONING

Pavlov's Dog Experiment

BEFORE CONDITIONING



DURING CONDITIONING



AFTER CONDITIONING



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